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To: Dr. D. Mills
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SSARR IMPLEMENTATION

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ABSTRACT

In cooperation with the Resources Utilization and the Civil Works Departments, the Stream Synthesis and Reservoir Regulation (SSARR) model was obtained from Hydro-Quebec, and installed on the IBM main frame at Ontario Hydro. Modifications as per the requirements of the users were made and tested. A preprocessing program to convert data from the existing river regulation models was developed and a procedure to facilitate user input was set up. The model will be useful in simulating the impact of various operating plans in river control applications.

1. INTRODUCTION

The Stream Synthesis and Reservoir Regulation (SSARR) model is a computer program developed by the U.S. Corps of Engineers for use as a simulation tool for river forecasting and river management activities. One version of the program is being used at Hydro-Quebec to model the Ottawa river. A Working Group consisting of members from the Resources Utilization Department, the Civil Works Department and the Operations Research Department was set up to install the model in Ontario Hydro for use by the Resource Utilization and Civil Works Departments. This report outlines the work performed to date:

(a) the installation of the model at Ontario Hydro's computer system,

(b) making modifications as per Ontario Hydro's requirements,

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(c) performing tests to verify proper operation,

(d) designing and developing a preprocessing program to convert data from existing river regulation programs.

2. PROGRAM OUTLINE AND USE

The SSARR model consists of three basic components:

(a) a watershed model for synthesizing run-off from snowmelt, etc,

(b) an operational river forecasting model, and

(c) a reservoir and channel routing and regulation model.

It is expected that our use will be limited to (c) above. That is, historic streamflow data at upstream points and regulation data will be input and the model will be used to route flow through the river system to provide a simulation of various possible plans.

The input data required for the model include

(a) fixed characteristics data, which describe the physical features of the reaches, reservoirs, etc,

(b) configuration data, which specify the relative positions of the components along the river system,

(c) variable data, which include the streamflow and reservoir data for the period under study as well as initial conditions data specifying the initial reservoir or lake elevations and outflows.

In addition, control information such as the routing intervals and total time period are also required. Details are available in Reference 1.

An unloaded version of the program and a copy of the model of the Ottawa river were obtained on tape from Hydro-Quebec. The program was loaded on the IBM system in Ontario Hydro and was tested successfully. Several modifications to the model, primarily involving the streamflows to suit the data available at Ontario Hydro, and the inclusions of some reaches not included in Hydro Quebec's version were made. The parameters of the reaches were converted to metric units and a preliminary approximation based on the physical characteristics of the reach was made for the newly included reaches. The new model for the Ottawa River System is shown in Figure 1. Table 1 lists the components in the model including reaches, lakes and reservoirs, inflows, and junctions and Table 2 lists the parameters used to model the reaches.

Fixed characterstics and configuration data for Ottawa river have been set up in disk datasets on the system. The variable data are obtained from a front-end program written by the Hydraulic Resources Development Group of the Resources Utilization Department.

The program retrieves the required data from the River Regulation Model (RRM) from RRM history files and outputs them in the SSARR format. It should be noted that, although the current testing has been limited to the Ottawa river system, the model is applicable for other river systems as well.

Appendix A lists the job control language (JCL) required for a sample run and Appendix B lists the procedure "SSARR" used in the JCL. The procedure is set up such that the various subsets of input data are in separate disk datasets. The procedure combines the three subsets of data to create the input dataset for "SSARR". In Appendix B, the terms "INDEX", "FIXED" and "CONFIG" correspond to the index data, the fixed characteristics data and the configuration data respectively. The default values for these datasets are set up to correspond to the Ottawa river system and are "CABV.SSARR.DATA(OTTAINDX)", "CABV.SSARR.DATA(OTTAFIXD)" and "CABV.SSARR.DATA(OTTACONF)" respectively. These default values will have to be overridden by the user by coding the appropriate values of these parameters on the "EXEC" card in the runstream shown in Appendix A if a different river system is being modeled. Several options were tested and the results were satisfactory. A typical run costs approximately $5.

3. CONCLUDING REMARKS

It is expected that the modified SSARR model will become the core component of a tool used for the simulation of various possible operating plans. It will be used to determine (a) energy outcomes, (b) level and discharge outcomes and (c) level of risk in violating energy limit requirements. Some additional work on the model is planned in order to increase its usefulness. The parameters of the reaches (Table 2) have to be verified to a greater precision. This will be done by trial and error using several simulations. An analysis of the probability distribution of the river flow at various points is also planned.

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REFERENCE

"Program Description and User Manual for SSARR", U.S. Army Engineer Division, North Pacific, Portland, Oregon, Sept. 1972.

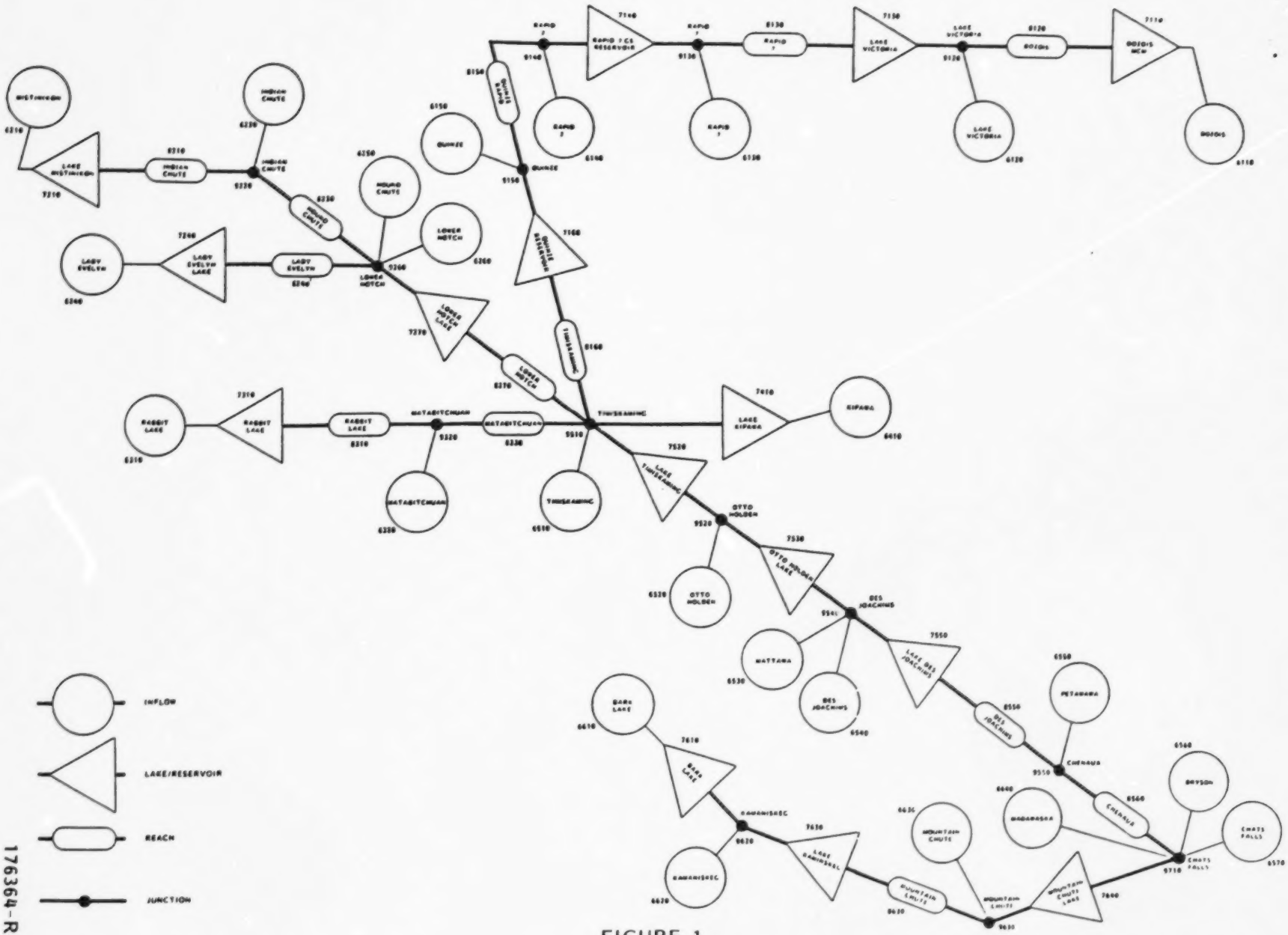

FIGURE 1
OTTAWA RIVER SYSTEM

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TABLE 1

OTTAWA RIVER MODEL COMPONENTS

INFLOWS

6110	DEUCES INFLOW	6410	KIPAWA INFLOW
6120	LAKE VICTORIA INFLOW	6510	TIMISKAMING INFLOW
6130	RAPID 7 INFLOW	6520	OTTO HOLDEN INFLOW
6140	RAPID 2 INFLOW	6530	MATTAWA INFLOW
6150	QUINZE INFLOW	6540	DES JOACHIMS INFLOW
6210	MISTINIKON INFLOW	6550	PETAWAWA INFLOW
6220	INDIAN CHUTE INFLOW	6560	BRYSON INFLOW
6240	LADY EVELYN INFLOW	6570	CHATS FALLS INFLOW
6250	HOUND CHUTE INFLOW	6610	BARK LAKE INFLOW
6260	LOWER NOTCH INFLOW	6620	KAMANISKEG INFLOW
6310	RABBIT LAKE INFLOW	6630	MOUNTAIN CHUTE INFLOW
6320	MATABITCHUAN INFLOW	6640	MADAWASKA INFLOW

LAKES/RESERVOIRS

7110	DOZOIS MDN	7410	LAKE KIPAWA
7130	LAKE VICTORIA	7520	LAKE TIMISKAMING
7140	RAPID 7 GS RES	7530	OTTO HOLDEN LAKE
7160	QUINZE RESERVOIR	7550	LAKE DES JOACHIMS
7210	MISTINIKON LAKE	7610	BARK LAKE RES
7240	LADY EVELYN LAKE	7630	KAMANISKEG LAKE
7270	LOWER NOTCH LAKE	7640	MOUNTAIN CHUTE LAKE
7310	RABBIT LAKE		

REACHES

8120	DOZOIS REACH	8270	LOWER NOTCH REACH
8130	RAPID 7 REACH	8310	RABBIT LAKE REACH
8150	QUINZE RAPID REACH	8330	MATABITUCHUAN REACH
8160	TIMISKAMING REACH	8550	DES JOACHIMS REACH
8210	INDIAN CHUTE REACH	8560	CHENAUX REACH
8230	HOUND CHUTE REACH	8630	MOUNTAIN CHUTE REACH
8240	LADY EVELYN REACH		

JUNCTIONS

9120	LAKE VICTORIA JN	9510	TIMISKAMING JN
9130	RAPID 7 JN	9520	OTTO HOLDEN JN
9140	RAPID 2 JN	9540	DESJOACHIMS JN
9150	QUINZE JN	9550	CHENAUX JN
9220	INDIAN CHUTE JN	9620	KAMANISKEG JN
9260	LOWER NOTCH JN	9630	MOUNTAIN CHUTE JN
9320	MATABITCHUAN JN	9710	CHATS FALLS JN

TABLE 2

ROUTING PARAMETERS FOR OTTAWA RIVER

In the SSARR model, the reaches are simulated by the equation:

$$TS = KTS * NP / Q^{n}$$

where

TS = Time of storage (lag) in hours
Q = Discharge in cms
KTS, NP, n are calibrated constants.

The following table gives the values of the constants as well as the physical characteristics for each reach in the Ottawa river system.

Reach Number	Reach Name	Length (km)	Delay (hrs)	NP	n	KTS
8120	Dozois	35	72	2	0.2	90
8130	Rapid 7	120	24	8	0.2	80
8150	Quinze Rapid	84	36	6	0.2	9
8160	Timiskaming	125	77	5	0.23	57
8210	Indian Chute	30	72	2	0.2	14
8230	Mound Chute	107	126	8	0.2	12
8240	Lady Evelyn	37	48	2	0.2	60
8270	Lower Notch	51	72	3	0.2	60
8310	Rabbit Lake	13	24	2	0.2	30
8330	Matabitchuan	55	72	4	0.2	45
8550	Des Joachims	49	24	3	0.2	20
8560	Chenaux	125	24	8	0.2	8
8630	Mountain Chute	64	24	7	0.2	17

APPENDIX A

SAMPLE RUNSTREAM TO RUN "SSARR"

This appendix lists the JCL and the data cards required for a simple run. The sample runstream shown below is stored in the dataset "CABV.SSARR.CNTL(RUN1)". It uses the procedure stored in the dataset "CABV.SSARR.CNTL(SSARR)". Appendix B lists the procedure and outlines the parameters that might be coded. The parameter HISTORY refers to the history file used and must be coded. In addition, three data cards are needed.

SAMPLE RUNSTREAM

```
//CABVS  JOB (0000,ROOM,01,10,,,1),' XXXXXXXXXXXXXXX ',MSGCLASS=Q,      00010000
//             CLASS=F,NOTIFY=CABV,MSGLEVEL=(1,1)                        00020000
//*                                                                      00030000
//*                                                                      00040000
//PROCLIB   DD    DSN=CABV.SSARR.CNTL,DISP=SHR                           00050000
//S1        EXEC  SSARR,HISTORY='H865050'                                00060000
//SYSIN     DD    *                                                      00070000
NOPRINT                                                                 00080000
METRIC   SELECTIVE                                                      00090000
SEP  1 1986 SEP 10 1986                                                 00100000
//                                                                      00110000
```

DATA CARDS

CARD NO.	ENTRY	FORMAT	COL. NO.	DESCRIPTION
1	NOPRINT/PRINT	A	1	Controls diagnostic print-outs
2	METRIC/IMPERIAL	A	1	Units to be used
	SELECTIVE/COMPLETE	A	9	Selective or complete retrieval
3	mmm,dd,yyyy	A3,1X,I2,1X,I4	1	Starting date: month, day, year
	mmm,dd,yyyy	A3,1X,I2,1X,I4	13	Ending date: month, day, year

APPENDIX B

THE PROCEDURE "SSARR"

This Appendix lists the procedure "SSARR" used to run the program. The procedure is contained in the member "SSARR" in the dataset "CABV.SSARR.CNTL".

```
//SSARR     PROC  PRGM=D24G001,PRGMIN=SSARRIN,                          00010000
//            STEPLIB='CABV.SSARR.LOAD',                               00020000
//            INDEX='OTTAINDX',                                        00030000
//            FIXED='OTTAFIXD',                                        00040000
//            CONFIG='OTTACONF',                                       00050000
//            DATAFIL='CABV.SSARR.DATA',                               00060000
//            HISTORY='H865050',                                       00070000
//            HISTI='CABO.OTTA.HISTI',                                 00080000
//            HISTD='CABO.OTTA.HISTD',                                 00090000
//            HISTS='CABO.OTTA.HISTS',                                 00100000
//            OUT3=Y,OUT6='*',OUTFILE=NULLFILE                         00110000
//*                                                                    00120000
//*********************************************************************00130000
//*                                                                   ***00140000
//*         PROCEDURE TO RUN THE PROGRAM 'SSARR'                      ***00150000
//*         ====================================                      ***00160000
//*                                                                   ***00170000
//*********************************************************************00180000
//*                                                                    00190000
//*      PARAMETERS:                                                   00200000
//*      -----------                                                   00210000
//*           PRGM = NAME OF THE 'SSARR' PROGRAM                       00220000
//*         PRGMIN = NAME OF THE 'RRM TO SSARR' PREPROCESSOR PROGRAM   00230000
//*        STEPLIB = DATASET CONTAINING THE ABOVE TWO LOAD MODULES     00240000
//*          INDEX = MEMBER NAME OF THE LAKE/INFLOW INDEX FILE         00250000
//*          FIXED = MEMBER NAME OF THE FIXED CHARACTERISTICS FILE     00260000
//*         CONFIG = MEMBER NAME OF THE CONFIGURATION FILE             00270000
//*        DATAFIL = DATASET CONTAINING THE ABOVE THREE MEMBERS        00280000
//*        HISTORY = HISTORY FILES SUFFIX (CHANGES EVERY YEAR)         00290000
//*          HISTI = NAME OF THE RRM HISTORY INDEX FILE                00300000
//*          HISTD = NAME OF THE RRM HISTORY DATA FILE                 00310000
//*          HISTS = NAME OF THE RRM HISTORY SYMBOL FILE               00320000
//*           OUT3 = OUTPUT CLASS FOR FILE 3 OUTPUT                    00330000
//*           OUT6 = OUTPUT CLASS FOR FILE 6 OUTPUT                    00340000
//*        OUTFILE = NAME OF THE SSARR OUTPUT FILE IF NEEDED           00350000
//*                                                                    00360000
```

```
//*****************************************************************************00370000
//*                                                                           00380000
//*          STEP 1 - RRM TO SSARR INTERFACE                                  00390000
//*                                                                           00400000
//*****************************************************************************00410000
//*                                                                           00420000
//SSARRIN   EXEC  PGM=&PRGMIN,REGION=0200K,TIME=1                             00430000
//STEPLIB   DD    DSN=&STEPLIB,DISP=SHR                                       00440000
//FT05F001  DD    DDNAME=SYSIN                                                00450000
//         DD     DSN=&DATAFIL(&INDEX),DISP=SHR                               00460000
//FT06F001  DD    SYSOUT=&OUT6                                                00470000
//FT14F001  DD    DUMMY                                                       00480000
//FT30F001  DD    DSN=&HISTI..&HISTORY,DISP=SHR                               00490000
//FT31F001  DD    DSN=&HISTD..&HISTORY,DISP=SHR                               00500000
//FT32F001  DD    DSN=&HISTS..&HISTORY,DISP=SHR                               00510000
//FT40F001  DD    DUMMY                                                       00520000
//FT41F001  DD    UNIT=SYSDA,SPACE=(CYL,(1,1)),                               00530000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=6160),DISP=(,PASS),            00540000
//            DSN=&&DAILY                                                   00550000
//FILEDEL   DD    DSN=&OUTFILE,                                               00560000
//            UNIT=SYSDA,VOL=SER=HSM001,SPACE=(TRK,(5,5)),                  00570000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=6160),DISP=(MOD,DELETE)        00580000
//*                                                                           00590000
//*****************************************************************************00600000
//*                                                                           00610000
//*          STEP 2 - PROGRAM SSARR                                           00620000
//*                                                                           00630000
//*****************************************************************************00640000
//*                                                                           00650000
//SSARR     EXEC  PGM=&PRGM,REGION=0200K,TIME=5                               00660000
//STEPLIB   DD    DSN=&STEPLIB,DISP=SHR                                       00670000
//FT03F001  DD    SYSOUT=&OUT3,DCB=(LRECL=133,BLKSIZE=1330,RECFM=FBA)         00680000
//FT05F001  DD    DDNAME=SYSIN                                                00690000
//SYSIN     DD    DSN=&DATAFIL(&FIXED),DISP=SHR                               00700000
//         DD     DSN=&DATAFIL(&CONFIG),DISP=SHR                              00710000
//         DD     DSN=&&DAILY,DISP=(OLD,DELETE)                               00720000
//FT06F001  DD    SYSOUT=&OUT6                                                00730000
//FT07F001  DD    DSN=&OUTFILE,                                               00740000
//            UNIT=SYSDA,VOL=SER=HSM001,SPACE=(TRK,(5,5)),                  00750000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=6160),DISP=(,CATLG)            00760000
//FT21F001  DD    UNIT=SYSDA,SPACE=(CYL,(10)),                                00770000
//            DCB=(RECFM=VS,LRECL=3516,BLKSIZE=3520)                        00780000
//FT22F001  DD    UNIT=SYSDA,SPACE=(CYL,(10)),                                00790000
//            DCB=(RECFM=VS,LRECL=3516,BLKSIZE=3520)                        00800000
//FT23F001  DD    UNIT=SYSDA,SPACE=(CYL,(10),,CONTIG)                         00810000
//*                                                                           00820000
//*****************************************************************************00830000
//*                                                                           00840000
```